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ROLE OF RAIN WATER HARVESTING IN ARTIFICIAL RECHARGE OF GROUND WATER

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ABSTRACT

This paper majorly focuses on role of rain water harvesting in artificial recharge of ground water in SBIT engineering college, Khammam, Telangana. Water is important for the survival of living organisms along with food, air etc. Ground water is the major source for domestic, industrial, agricultural, aquaculture etc. Ground water is a resource of immense value that is heavily used by people. The protection of ground water from contamination, however, has long been neglected. In recent years, the need for ground water protection and management has been recognized.

Due to continuous pumping of ground water, the water table is decreasing rapidly and if this problem is not taken seriously, then the future generations has to face severe crisis of water. Rains are the main source of water and if this rainwater is harvested, scarcity of water can be eliminated. Rain water is bacteriologically pure, free from organic matter and soft in nature. So, rainwater is an ideal solution for water problems where there is inadequate water supply. Rainwater harvesting is a simple technique of collecting the rain water from either surface or rooftop of buildings, or both surface and rooftop and also can be used to recharge the aquifers.

Key words: Rainwater, Artificial recharge, Groundwater, aquifer, Recharge pits.

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1. INTRODUCTION

Water is essential for the existence of all the living organisms. The demand for water is increasing due to so many reasons like increasing population, industrialization, urbanization, several climatic changes etc., To avoid that problem now a days we are adopting rainwater harvesting technique. Decreasing ground water is due to low water storage capacity, low infiltration, larger inter annual fluctuations of precipitation (due to monsoonal rains) and high evaporation demand. Rain water harvesting is used for collecting and storing runoff water resulting from rain in soil profile and reservoir both over surface/under surface [1].

Water is a most important renewable natural resource which plays an important role in the survival of living organisms [2]. Water is one of the most abundantly available substances in nature, covering more than 70% of the earth's surface. Water of the good quality is required for living organisms. At the same time growing populations, progressive industrialization and intensification of agriculture have led to increased pollution of water resources [3].

Rain water collected through rain water harvesting is utilized for recharging both open wells and bore wells [4]. Annually replenish able resources are assessed as 432 billion cubic meters (BCM). The basic need for increasing the groundwater recharging is the growing population which increased the demand of water resources. India's population has recently crossed the one billion mark, hence due to this increased population, our country is facing serious threat as there is a huge gap between the demand for water and the supply is getting widened day by day [5].

Although water is an important for survival of human being as much as food, air etc, but hardly any attention is paid for its economical use and conservation of this precious resource. Due to indiscriminate pumping of ground water, the water table is going down abnormally and if the problem is not given a serious look then the future generations may have to face severe crisis of water. Rains are the main source of water and if rain water is harvested the scarcity of water can be eliminated together [6].

So to overcome this problem, from our ancient days itself there are lot of widely developed techniques to harvest rainwater, which are simple, efficient and cost effective. A mix of ancient and modern techniques must be implemented to improve the water harvesting methods in our country.

1.1. Artificial recharge

Artificial recharge is the planned, human activity of augmenting the amount of ground water available through works designed to increase the natural replenishment or percolation of surface waters in to the ground water aquifers, resulting in a corresponding increase in the amount of ground water [7].

1.2. Artificial ground water recharge in India

Artificial ground water recharge methods have been extensively used in the developed nations for several decades, their use in developing nations, like India has occurred only recently.

Various techniques for artificial ground water recharge have been employed in the states of Maharashtra, Gujarat, Tamilnadu, and Kerala. Artificial Recharge has several potential advantages and disadvantages, The use of aquifers for storage and distribution of water and removal of contaminants by natural cleansing process that occurs as polluted rain and surface water in filtrate the soil and percolate down through the various geological formations, The main disadvantage is unless significant volumes of water are injected in an aquifer, ground water recharge may not be economically feasible [8].

2. MATERIALS AND METHODS

2.1. Study area

Swarna Bharathi Institute of Science & Technology is an engineering college located in Khammam city, which is one of the major city located in the Indian state of Telangana. It is located about 193 Kilometers to the east of the state capital of Telangana (Hyderabad). The average elevation of Khammam city is about 107 meters (351.05 feet) and its geographical area is about 94.37 square kilometers. The city is situated in north latitude 16˚45' to 18˚35' and east longitude 79˚47' to 81˚47' (Figure-1, 2, 3).

Figure 1 map of Study area of Khammam district.

Figure 2 Google map of SBIT Engineering College, Khammam.

Figure 3 Image of SBIT Engineering College, Khammam.

2.2. Water Table Fluctuation in Khammam District

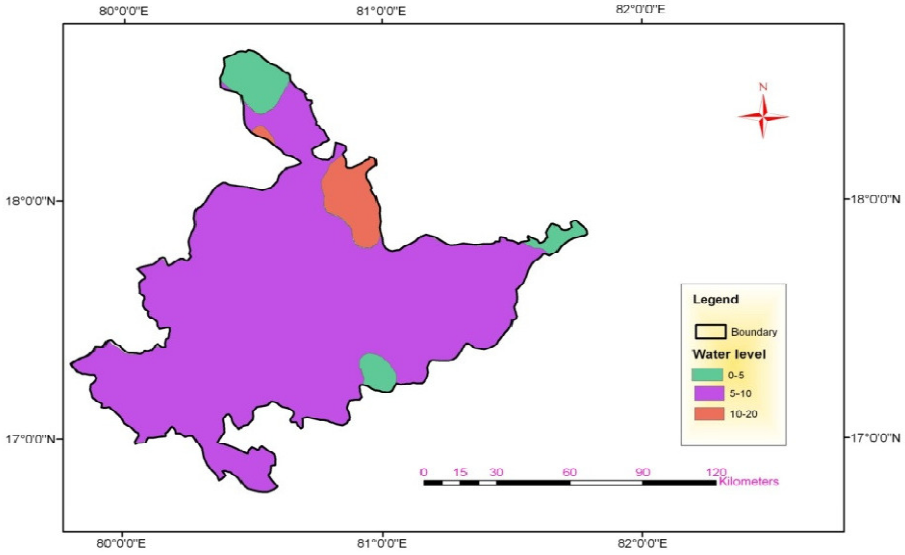

Figure 4 Ground Water table Fluctuation of Khammam District.

Water table fluctuation map is prepared by using action plan map of Khammam District which has been collected from Central ground water Board, Hyderabad. The maximum water level range is between 10-20m.bgl and minimum water level range is between 0-5 m.bgl. The water table fluctuation levels of Khammam district rising between 6-21.77m.bgl (Figure-4) [9]. The Khammam segment of the South Indian carton is in the Krishna and Godavari river basins. Physiographic ally, the area falls under the uplands category and it shows a dendraitic drainage pattern with a general flow toward the two major river courses. The Munneru River is a major source recharge for ground water in the Khammam area. [10].

2.3. Ground water table

With the reference of rainfall data shows effect on ground water table level (Table-1, Figure-5) [11], in Khammam, in 2011 the water table level is available at 1.65 meters depth from the surface. It indicates that rainfall and ground water table levels are in proportional ratio. From the data available in the above tables like rainfall data and water level data and the runoff co-efficient, we can estimate the total quantity of water that can be collected (in m^3).

Table 1(A) Groundwater level report from the year 2008-2016 (Khammam)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2008	2.17	3.31	3.75	3.89	2.44	3.32	2.59	0.97	0.96	1.20	1.48	1.65	2.31
2009	1.93	2.33	2.47	2.92	3.70	4.21	4.93	4.70	4.83	4.25	4.63	5.11	3.83
2010	5.02	-	5.82	6.25	6.53	4.97	4.62	0.90	1.47	2.31	1.29	1.06	3.35
2011	1.37	1.75	1.34	2.18	5.48	2.00	-	1.52	1.21	1.61	1.98	2.39	1.65
2012	2.43	2.85	3.06	3.73	4.05	4.45	4.20	2.82	1.55	1.15	3.29	1.78	2.94
2013	3.57	2.62	3.01	3.78	3.91	3.86	-	0.45	1.52	0.45	0.74	0.85	2.06
2014	1.15	2.69	3.65	2.59	1.40	1.90	1.95	2.70	3.02	2.80	1.00	3.62	2.37
2015	3.80	4.05	4.45	5.02	4.50	2.90	2.65	1.50	1.38	2.38	2.25	2.56	3.12
2016	2.95	3.35	3.65	4.25	4.50	2.55	2.30	2.17	1.27	1.50	0.65	0.78	2.49

Table 1(B) Groundwater level report

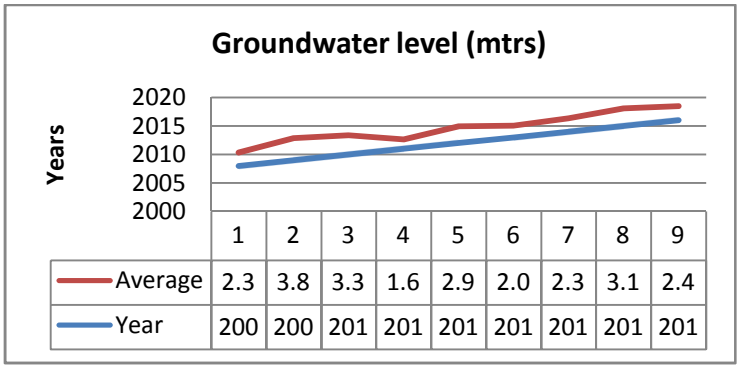

Figure 5 Groundwater level report from the year 2008-2016 (Khammam)

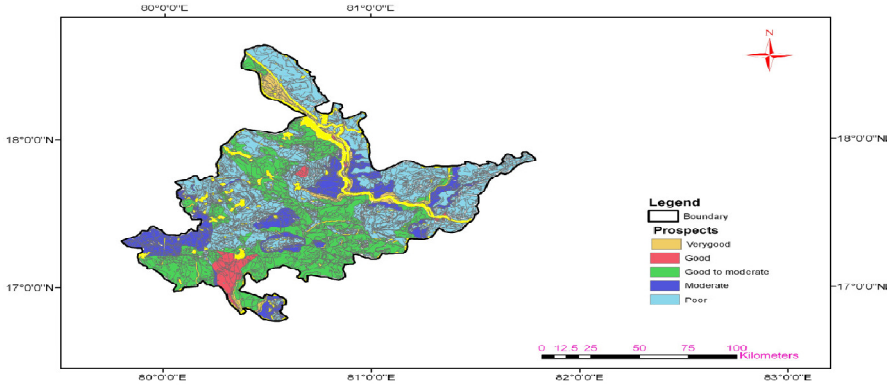

Figure 6 Identification Ground water prospects of Khammam District

Table 2 Ground water prospects of Khammam District

S.No	Ground water prospects Zones	Area in Km^2
1	Very good	511.45
2	Good	452.703
3	Good to Moderate	55458.89
4	Moderate	2301.82
5	Poor	6171.39

Khammam District ground water prospects are observed as very good as 511.45 Km^2, Good as 452.703 Km^2, Good at moderate 55458.89 Km^2, Moderate 2301.82 Km^2, poor as 6171.39 Km^2 in this Khammam Urban area containing of moderate levels shown in Figure 6, Table 2, [12].

2.4. Groundwater Balance Equation

Considering the various inflow and outflow components in a given study area, the ground water balance equation can be written as

$$R_r + R_c + R_i + R_t + S_i + I_g = E_t + T_p + S_e + O_g + \Delta S$$

Where, R_r = recharge from rainfall;

R_c = recharge from canal seepage;

R_i = recharge from field irrigation;

R_t = recharge from tanks;

S_i= influent seepage from rivers;

I_g = inflow from other basins;

E_t = evapotranspiration from groundwater;

T_p = draft from groundwater;

S_e = effluent seepage to rivers;

O_g = outflow to other basins; and

ΔS = change in groundwater storage.

The groundwater balance equation therefore generally does not balance, even if all its components are computed by independent methods. The resultant discrepancy in groundwater balance is defined as a residual term in the balance equation, which includes the quantitative determination of various components as well as values of the components which have not been accounted in the equation [13].

3. RECHARGE PITS

Recharge pits are normally excavated pits, which are sufficiently deep to penetrate the low permeability layers overlying the unconfined aquifers. They are similar to recharge basin in principle, with the only difference begin that they are deeper and have restricted bottom area. In many such structures, most of the infiltration occurs laterally through the wall of the pit as in most layered sedimentary or alluvial material the lateral hydraulic conductivity is considerably higher that the vertical conductivity[14].

3.1. Description of Soakpit Design

The distance between SBIT main block to soak pit is 82.7m, and the distance between bore point and soak pit is 3.6m, so based on the catchment area of the SBIT main block we excavated soak pit up to 10m depth. Up to this depth we provided cement rings, each one of 4feet diameter and 1feet height. The total volume of the soak pit is 3.857 cubic meters, so that we can collect up to 415.737 Lt/day (figure-7).

Figure 7 Constructed Recharge Soak pit, SBIT Campus

4. CONCLUSION

Ground water is immensely important to suffice human needs in both urban and rural areas of Developing nations [15]. Hence from the above analysis, we can conclude that the best way to artificially recharge the groundwater using low cost-effectiveness and sustainable method and also along with lowest level of contamination is Rainwater Harvesting.

The Artifical Recharge of groundwater using Rainwater Harvesting System must be implemented in each and every city, town and Mandals in order to meet the increasing rate of over utilization of water. The groundwater conservation and artificial recharge structures must be constructed in watershed wise and this situation must be considered on war foot basis and by using scientific methods like GIS (Geographical Information System), the area where the necessity of artificial recharge structures are required must be identified and remedial measures must be taken immediately for meeting the future requirements and also to minimize the moderately high level requirement of water. Hence, the artificial recharge of ground water must be done in order to improve the depleted aquifers. The most-effective, easy and long-lasting method used to increase the ground water level is the Rainwater Harvesting.

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